PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

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International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 1.158.PCT

Box No. I TITLE OF INVENTION

Structure of Optically Effective Diffraction Security Elements and Apparatus for Examining such Elements

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

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Continuation of Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTOR(S)

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This person is:

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☐ applicant and inventor
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Box No.V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked)*:

Regional Patent

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Box No. VI PRIORITY CLAIM ☐ Further priority claims are indicated in the Supplemental Box.

Filing date of earlier application *(day/month/year)*	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 12 August 1997 12-08-1997	197 34 855.6	Germany		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

** Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA/

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country (or regional Office)

Box No. VIII CHECK LIST: LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	:	4
description (excluding sequence listing part)	:	10
claims	:	5
abstract	:	1
drawings	:	4
sequence listing part of description	:	
Total number of sheets	:	24

This international application is **accompanied** by the item(s) marked below:

1. ☐ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*:

Figure of the drawings which should accompany the abstract:

Language of filing of the international application:

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

signed Wolfgang Heitsch

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1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
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Certified translation from the German language

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CONSTRUCTION OF DIFFRACTION-OPTICALLY EFFECTIVE SAFETY ELEMENTS AND A DEVICE FOR TESTING SUCH ELEMENTS

This invention relates to the construction of diffraction-optically effective safety elements and a device for testing such elements.

To date, documents with diffraction-optically effective safety elements, in particular holograms, have been tested with costly optical testing equipment. In these procedures, the test object has to be positioned very exactly. The entire testing process takes so long that these test procedures cannot be used in high-speed processing machines. Testing of, for example, documents with so-called optical variable devices (OVDs) in a document processing machine is impossible, as it runs at a high speed. A method and device of forge testing holographically protected identity cards is disclosed in DE 27 47 156. The OVD is reproduced and a visual check is carried out. This method is not suited to high-speed, efficient, person-independent testing. A device for generating scanning patterns which are tested by means of laser, mirror and lens system as well as a photodetector is described in EP 0 042 946. The economic expenditure is also in this case very high. It would increase further if the test objects are to be tested without prior sorting. To avoid presorting, the forge test system would have to be arranged several times. In addition, demetallizations in diffraction-optically effective safety elements are known which have been tested only by means of optical methods so far.

It is the object of the invention to eliminate the disadvantages of the prior art and to propose a construction of diffraction-optically effective safety elements, in particular OVDs, holograms or kinegrams, which can be tested rapidly, person-independently and

inexpensively. It is another object of the invention to propose a device for the testing of documents containing such safety elements. The device is intended for use in document processing machines as well as manual test units for testing documents with diffraction-optically effective safety elements.

This problem is solved by the following description of the invention.

Holograms and other diffraction-optically effective safety elements for the protection of certificates and other securities as well as banknotes against forging are now used more and more widely. Such documents are, for example, the DEM banknotes issued in 1997 which have a diffraction-optically effective safety element in the form of a kinegram in addition to the electrically conductive safety strip. Rapid testability is another safety stage in the valuation of diffraction-optically effective safety elements as a feature of authenticity. Diffraction-optically effective safety elements are composed of a metallized layer, among other things. This metallization layer is electrically conductive. The electrical conductivity changes with the thickness of the layer. In accordance with the invention, the diffraction-optically effective safety element has a discontinuous metallization layer and/or partially metallic layers and/or zones of metallic layers in different planes which represent an aimed electrical coding of information. The form of coding resembles geometrical figures, in particular lines, grid lines, arcs and/or circles, which are arranged both regularly and irregularly. A partially metallized layer arranged on a substrate comprises several demetallized segments. A discontinuous metallization layer comprises segments of different electrical conductivity.

The device has a capacitively working scanner. This scanner is composed of a large number of transmitting electrodes arranged side by side and a receiving electrode running parallel to this side-by-side arrangement. The scanner is arranged in a document processing machine in such a way that the optical or mechanical sensors provided in usual document processing machines activate the test device according to

the invention. To avoid detecting and measuring errors, a sensor carrier should be used preferably. This sensor carrier accommodates all sensors required for testing. This allows the distances between the sensors to be minimized and the sensors always to be arranged in defined positions. Activation of the individual transmitting electrodes by electric energy is staggered by means of the electronic activation system with a change-over frequency in the kHz range. In addition to the power supply unit, the electronic activation system comprises as major components a multiplexer, an oscillator for the supply of energy to the transmitting electrodes and an oscillator for the activation of the multiplexer.

The energy of the respective activated transmitting electrode is capacitively overcoupled if there is electrical conductivity between the transmitting and the receiving electrode. If there is no electrically conductive feature, no energy will be transferred between the transmitting electrode activated and the receiving electrode. The signal response in the receiving electrode is converted into a relevant signal picture. The signal picture depends on the structure of the metallized layer of the diffraction-optically effective element. If the diffraction-optically effective elements have a discontinuous metallization layer, several segments of the metallization layer have different electrical conductivities. An electronic evaluation system downstream from the receiving electrode compares the signal picture of the test object with the relevant reference signals. The electronic evaluation system is mainly composed of a power supply unit, an amplifier, a demodulator, a comparator, a microprocessor with memory as well as filters for the suppression of external and interference signals.

In addition to the software for the microprocessor, reference signal pictures for comparing with the sampled signal picture of the test document are stored in a memory. As the scanner goes beyond the overall width of the document, the device according to the invention detects every electrically conductive feature. The comparison with the reference signal pictures provides a classifying signal for reprocessing. Therefore, a

document detected as a forgery, for example, could be sorted out by stopping the test device. To reduce interference effects, the sensor carrier is firmly connected to the mounting plate holding the electronic activation and evaluation systems.

The entire test device is arranged within the document processing machine so that the required space is relatively small. The transmitting and receiving electrodes are arranged above or below the documents in the document processing machine in such a way that a reliable scanning is ensured. This is done for example by means of ribbons or in the area of reversing devices so that the document during transport is pressed against the transmitting and receiving electrodes.

In a modified arrangement of the electrodes without affecting the scope of the invention, a long stretched-out transmitting electrode is arranged parallel to the side-by-side arrangement of a large number of receiving electrodes. In this case, the signals received are processed by means of a multiplexer. The rest of the electronic evaluation system is the same as described above.

In another embodiment of the transmitting and receiving electrodes, a large number of transmitting and receiving electrodes are arranged side by side and/or seriately. For both the activation and the reception of signals, multiplexing or demultiplexing is used.

If the test device is to be used in manual units, the manual units comprise appropriate devices for the transport of the document or the scanner which function like the transport devices in copiers, optical image feeding scanners or fax machines.

As a modification, a device is provided which defines the position of a capacitively working scanner of the test device according to the invention to the document by means of stop elements. In this case, the document is tested only in the area of the transmitting and receiving electrodes.

The features of the invention will appear from the description and drawings in addition to the claims, the individual features as individual or several things in the form of subcombinations representing advantageous, patentable embodiments for which

protection is claimed here. The invention will now be explained in greater detail with reference to embodiments thereof which are represented in the accompanying drawings, wherein

Fig. 1 is a schematic diagram of a document with an OVD with meander-like demetallized layers;

Fig. 2 is a schematic diagram of a document with an OVD with strip-like demetallized layers;

Fig. 3 is a schematic diagram of a document with an OVD with strip-like demetallized layers;

Fig. 4 is a schematic diagram of a document with an OVD with grid-like demetallized layers;

Fig. 5 is a schematic diagram of a document with an OVD with several safety elements;

Fig. 6 is a block diagram of a test device;

Fig. 7 is a schematic diagram of the scanner with a large number of transmitting electrodes and one receiving electrode;

Fig. 8 is a schematic diagram of the scanner with one transmitting and a large number of receiving electrodes;

Fig. 9 is a schematic diagram of the scanner with a large number of transmitting and receiving electrodes;

Fig. 10 is a schematic diagram in a side view of the scanner and a document to be tested;

Fig. 11 is a schematic section through an OVD with demetallized segments;

Fig. 12 is a voltage-time diagram of the evaluation signal;

Fig. 13 is a schematic section through an OVD with a discontinuous metallization layer;

Fig. 14 is a voltage-time diagram of the evaluation signal.

Each of the embodiments shown in Fig. 1 to 5 shows a document with safety elements according to the invention, the capacitively working scanner of the device according to the invention being also represented schematically.

Fig. 2 shows the schematic structure of a printing image **1** with a metallization layer **2**. The metallization layer **2** has a demetallized zone **3**. Seen from the top, the demetallized zone **3** has the form of a meander. The width of the demetallized zone **3** with the form of a meander is larger than the smallest distance between two electrodes. The capacitively working scanner **4** is composed of a large number of transmitting electrodes **5** arranged side by side and a receiving electrode **6** arranged parallel to this side-by-side arrangement.

Fig. 2 shows the schematic structure of a printing image in which metallized strip-like zones **7** and demetallized strip-like zones **8** are alternately arranged parallel to each other. The zones **7**, **8** having the form of strips when seen from the top run parallel or perpendicular to the direction of document transport. The latter case is shown in Fig. 3. The distance between two zones of equal electrical conductivity ranges from 0.2 to 1.0 mm. The width of the zones of equal electrical conductivity varies.

A combination of the features of embodiments 2 and 3 is shown in Fig. 4. Parallel to the direction of document transport, metallized strip-like zones **7** and demetallized strip-like zones **8** are arranged alternately. The metallized zones **7** are interrupted by a strip-like demetallized zone **9** running perpendicular to them.

Fig. 5 shows a document with several printing images. The aimed combination of different printing images results in a further coding. This increases the testing reliability.

Fig. 6 to 9 show the block diagramm as well as different embodiments of the capacitively working scanner **4**.

Fig. 6 shows the block diagramm of the test device according to the invention, which comprises an electronic activation system, a capacitively working scanner **4** and an electronic evaluation system. In addition to the power supply unit, the electronic activation system is mainly composed of a demultiplexer **10**, an oscillator **11** for supplying the energy to the transmitting electrodes and an oscillator **12** for the activation of the demultiplexer.

The electronic evaluation system is mainly composed of a power supply unit, an amplifier **13**, a demodulator **14**, a comparator **15**, a microporcessor **16** with memory as well as filters for the suppression of external and interference signals.

The transmitting and receiving electrodes are embedded in a sensor carrier. The electrodes form over the entire feeding width of the document a capacitively working scanner **4**. The strip-like receiving electrode runs transversely to the direction of document feeding. The transmitting electrodes are arranged parallel to the receiving electrode. The distance between a transmitting electrode and the receiving electrode is defined by the document-specific electrically conductive testing features. The side-by-side arrangement of several transmitting electrodes allows several electrically conductive features to be simultaneously detected along the longitudinal axis of the capacitively working scanner **4**. The resolution achievable with this arrangement depends on the number of transmitting electrodes used. In this embodiment, the resolution is one scannable point per millimetre both in the longitudinal and transverse direction. The minimum distance between adjacent transmitting electrodes is limited by the interfering capacitive coupling among each other. To avoid this and to reduce interfering effects of adjacent transmitting electrodes, the transmitting electrodes are activated one after the other by a multiplexer **10**. The arrangement of the transmitting electrodes over the entire feeding width of the document allows the documents to be tested independently of their position. This means that presorting of several documents for a document processing machine is no longer needed.

Fig. 7 shows the schematic diagram of the scanner **4** with a large number of transmitting electrodes **5** and one receiving electrode **6**. Activation and evaluation are done according to the block diagram shown in Fig. 6.

Fig. 8 shows a schematic diagram of an embodiment of the capacitively working scanner **4** with one transmitting electrode **17** and a large number of receiving electrodes **18**. As a modification of the block diagram of Fig. 6, the transmitting electrode **7** is activated by means of an oscillator. The signals of the receiving electrodes **18** are processed by means of a multiplexer. The rest of the electronic evaluation system comprising the power supply unit, an amplifier, a demodulator, a comparator, a microprocessor with

memory as well as filters for the suppression of external and interference signals resembles that of the block diagram shown in Fig. 6.

Fig. 9 shows the schematic diagram of another embodiment of the capacitively working scanner with a large number of transmitting electrodes **19** and a large number of receiving electrodes **20**. These are arranged alternately and seriately. Therefore, both the activation signals of the transmitting electrodes **19** and the evaluation signals of the receiving electrodes **20** are processed by the multiplexing or demultiplexing method.

Fig. 10 shows in a side view a schematic diagram of the capacitively working scanner **4** and a document to be tested. The printing image comprises lines **21**. The paper of the test object serves as an electrical insulator.

Fig. 11 shows a schematic section through a printing image with a carrying layer **23** and a partial colour print. The partial paint coat **24** contains several colourless segments **25**. The relevant evaluation signal is shown in a voltage-time diagram in Fig. 12.

Fig. 13 shows a schematic section through a colour print with a carrying layer **26** and a discontinuous paint coat **27**. The discontinuous paint count **27** contains segments **28**, **29**, **30**, **31**, **32** with different electrical conductivity. The relevant evaluation signal is shown in a voltage-time diagram in Fig. 14.

In the present invention, the construction of prints with electrically conductive feature paints and a device for testing such features were explained with reference to embodiments thereof. It is to be understood, however, that the present invention is not limited to the details of the description in the embodiments, as alterations and modifications are claimed within the scope of the patent claims. In addition to the diffraction-optically effective safety element, other electrically conductive features are detected with the device according to the invention. The aimed combination of diffraction-optically effective safety elements with other electrically conductive features results in a further coding. In addition, other electrically conductive testing features such as electrically conductive safety threads can be detected by means of the test device according to the invention.

We claim:

1. Construction of diffraction-optically effective safety elements in documents wherein the diffraction-optically effective safety element is provided with an aimed electrical coding of information comprising a discontinuous metallization layer and/or partially electrically conductive metallic layers and/or zones of metallic layers in different planes.

2. The construction of claim 1 in which the form of coding resembles geometrical figures, in particular lines, grid lines, arcs and/or circles.

3. The construction of claim 1 in which the form of coding resembles regularly or irregularly arranged geometrical figures, in particular lines, grid lines, arcs and/or circles.

4. The construction of claim 1 in which a demetallized zone **(3)** has the form of a meander when seen from the top.

5. The construction of claim 1 in which metallized strip-like zones **(7)** and demetallized strip-like zones **(8)** are alternately arranged parallel to each other, the strip-like zones running parallel or perpendicular to the direction of document transport when seen from the top.

6. The construction of claim 1 in which the distance between two zones of equal and/or different electrical conductivity corresponds to the shortest distance between two electrodes.

7. The construction of claim 6 in which the distance between two zones of equal and/or different electrical conductivity is at least 0.1 mm.

8. The construction as claimed in one or several of the preceding claims in which the metallized zones **(7)** are interrupted by one or several demetallized zones (9) running perpendicular to the metallized zones.

9. The construction as claimed in one or several of the preceding claims in which the diffraction-optically effective safety element is an optical variable device **(1)**.

10. The construction as claimed in one or several of the preceding claims in which the diffraction-optically effective safety element is a hologram.

11. The construction as claimed in one or several of the preceding claims in which the diffraction-optically effective safety element is a kinegram.

12. A device for the testing of documents with diffraction-optically effective safety elements including
a capacitively working scanner **(4)** whose width exceeds the largest width of the document, comprising a side-by-side arrangement of a large number of electrodes, an electronic activation system and an electronic evaluation system for the comparison of the signal response of the documents to be tested with the relevant reference signal responses.

13. The device of claim 12 in which
a large number of electrodes are arranged side by side and/or in several rows.

14. The device of claim 12 in which
the electronic activation system comprises a power supply unit, a multiplexer **(10)**, an oscillator **(11)** for the supply of energy to the transmitting electrodes (5) and an oscillator **(12)** for the activation of the multiplexer **(10)**.

15. The device of claim 12 in which

the electronic evaluation system comprises a power supply unit, an amplifier (13), a demodulator **(14)**, a comparator **(15)**, a microprocessor **(16)** with memory as well as filters for the suppression of external and interference signals.

16. The device as claimed in one or several of claims 12 to 15 in which

the smallest distance between electrodes is less than 0.5 mm.

17. The device as claimed in one or several of claims 12 to 16 in which

the distance between a transmitting electrode **(5)** and the receiving electrode **(6)** is at least 0.5 mm.

18. The device as claimed in one or several of claims 12 to 17 in which

the device is arranged in high-speed document processing machines.

19. The device as claimed in one or several of claims 12 to 18 in which

the device is arranged in manual units.

20. The device as claimed in one or several of claims 12 to 19 in which

the device is arranged in document reading units.

21. The device as claimed in one or several of claims 12 to 20 in which

the scanner is arranged over the entire width of the document in such a way that diffraction-optically effective safety elements on one and the same document which are different in appearance but have the same electrical properties are compared by means of a microprocessor.

22. The device as claimed in one or several of claims 12 to 21 in which

the scanner is arranged over the entire width of the document in such a way that

diffraction-optically effective safety elements on one and the same document which have the same appearance but are different in electrical properties are compared by means of a microprocessor.

Fig. 6: Output signal

Fig. 11: 24 - printing ink

23 - paper or other carrier

Fig. 13: 26 - carrier (paper)

Printing ink was applied with varying thickness

Summary

This invention relates to the construction of diffraction-optically effective safety elements and a device for testing such elements. Holograms and other diffraction-optically effective safety elements for the protection of certificates and other securities as well as banknotes against forging are now used more and more widely. In accordance with the invention, the diffraction-optically effective element has a discontinuous metallization layer and/or partially metallic layers and/or zones of metallic layers in different planes which provide an aimed electrical coding of information. The device comprises a capacitively working scanner. The scanner comprises a large number of transmitting electrodes arranged side by side and a receiving electrode running parallel to this side-by-side arrangement. The scanner is arranged in a document processing machine in such a way that the optical and mechanical sensors provided in usual document processing machines activate the test device according to the invention. The energy of the respective transmitting electrode activated is capacitively overcoupled if there is electrical conductivity between this transmitting and the receiving electrode. If there is no electrically conductive feature, no energy will be transferred between the transmitting electrode activated and the receiving electrode. The signal response in the receiving electrode is converted into a relevant signal picture. The signal picture depends on the structure of the metallized layer of the diffraction-optically effective element. An electronic evaluation system downstream from the receiving electrode compares the signal picture of the test object with the relevant reference signals.

Legends to illustrations

1 OVD
2 Metallization layer
3 Demetallized zone
4 Scanner
5 Transmitting electrode
6 Receiving electrode
7 Metallized zone
8 Demetallized zone
9 Demetallized zone
10 Demultiplexer
11 Oscillator for transmitting electrode
12 Oscillator for demultiplexer
13 Amplifier
14 Demodulator
15 Comparator
16 Microprocessor
17 Transmitting electrode
18 Receiving electrode
19 Transmitting electrode
20 Receiving electrodes
21 Partial metallization
22 Carrying film
23 Carrying layer
24 Partially metallized layer
25 Demetallized segments
26 Carrying layer
27 Discontinuous metallization layer
28 to 23 Segments of the discontinuous metallization layer

The translation comprises fourteen (14) pages.

I, a translator of the English and Japanese languages who was officially appointed and generally sworn by the President of the Regional Court of Dresden, do hereby certify that the above translation of the certificate submitted to me as a copy and drawn up in the German language is correct and complete.

Dresden, 14 April 1998